REMARKS/ARGUMENTS

In the subject Office Action dated 02/22/2006, Claims 1, 3-6, 8-10, and 12-13 are pending in the application, and were rejected under 35 U.S.C. 102(b) as being unpatentable over USPN 6,253,546 to Sun et al. (hereafter "Sun et al."). Claims 2, 7, and 11 were previously cancelled. In this response Applicant has cancelled all pending claims 1, 3-6, 8-10, and 12-13, and added new claims 14-31 to more clearly point out aspects of the present invention that distinguish over Sun et al.

As the previously pending claims were amended several times during prosecution, these prior pending claims have been cancelled rather than making further lengthy amendments that the Applicant believes would be more confusing than helpful to the Examiner. As a result, new claims 14-31 have now been added to more clearly point out aspects of the invention that previously may not have been appreciated. This will hopefully reduce rather than increase the effort required by the Examiner in concluding the examination of the present application. As pointed out below, no new matter has been added by the introduction of the new claims 14-31, and much of the language used in these new claims has been considered by the Examiner in pervious office actions.

New independent claims 14, 20, and 26 correspond respectively to cancelled claims 1, 6, and 10, with the exception that these new claims now particularly point out that the present invention computes a feed-forward compensating torque, which consists of a single estimate for the decrease in engine torque during the regeneration of the lean NOx trap. As evident from the flow chart 200 of FIG. 5, the feed-forward compensating torque consists of a single estimate because the feed-forward compensating torque is computed only once at step 214 upon initiation of the regeneration process at step 208. This single estimate is then used repeatedly during the regeneration process by determining the base desired torque, increasing the base desired torque by the feed-forward compensating torque to obtain an adjusted desired torque, and then controlling engine operation based upon the adjusted desired torque (see the loop repeating steps 216, 218, and 220 in FIG. 5, and the associated discussion in paragraphs [0038] and [0039]). In doing so, the present invention makes use of the conventional torque based engine control system (see paragraph [0010] and [0035] in the

specification.

New claims 15, 21, and 27 point out that the single estimate for the feed-forward torque is computed based upon the air-fuel ratios associated with the stratified lean engine operation and the homogeneous rich engine operation prior to and after initiation of the regeneration of the lean NOx trap. Support for these claims is provided by the specification in paragraph [0026], and the following paragraphs [0027] to [0036], which describe the computation of the single estimated value for the brake torque given by Equation (4), which is applicable during the regeneration of the lean NOx trap.

New claims 16, 22, and 28 point out that the single estimate for the feed-forward torque is computed base upon the engine air charge per cylinder and exhaust gas recirculation mass fraction associated with the stratified lean engine operation and the homogeneous rich engine operation prior to and after initiation of the regeneration of the lean NOx trap. Support for these claims is also provided in paragraph [0026] and the following paragraphs [0027] to [0030].

New claims 17, 23, and 29, correspond respectively to cancelled claims 3, 8, and 12, as supported in the specification at paragraph [0024].

New claims 18, 24, and 30 correspond to cancelled claim 4, indicating that the base desired torque is determine in accordance with the throttle pedal position, the cruise control setting, or the idle speed controller as indicated in the specification at paragraph [0012].

New claims 19, 25, and 31, correspond respectively to cancelled claims 5, 9, and 13, as supported in the specification at paragraph [0040] and by steps 220 and 222 shown in FIG. 5.

In the previous office actions, the claims presented to the Examiner were rejected under 35 U.S.C. 102(b) as being anticipated by the Sun et al. Sun et al. discloses a control scheme for an internal combustion engine, which includes feed-forward and feedback controls. The feed-forward control of Sun et al. is based upon the use of the torque equation (1) to compute values for engine fueling rate $W_{ff}(t)$, and spark timing $d_{ff}(t)$ that keep engine torque constant as the throttle opening θ_{th} is controlled to follow a predetermined trajectory $\theta_{th} = \theta(t)$ during the purging (or regeneration) of the lean NOx trap (see col. 4, at lines 43-45).

Equation (2) is also used to compute a reference trajectory of intake manifold pressure $P_m(t)$ as the throttle follows its predetermined trajectory $\theta(t)$ (see col. 4, lines 38-44).

It is particularly important to note that in Sun et al., the term f(N,P) in the torque Equation (1) is described as a polynomial function representing pumping losses and mechanical rubbing friction, which is proportional to intake manifold pressure P (see col. 4, lines 21-24). This term f(N,P) then represents the decrease in engine torque due to pumping or braking loss associated with the closing of the throttle θ_{th} during the purging or regeneration of the lean NOx trap. Consequently, the feed-forward control scheme of Sun et al. requires new values for the term f(N,P) representing the pumping loss to be computed continuously, thereby providing different estimates for the decrease in engine torque during the purge or regeneration process of the lean NOx trap, where the different estimates vary in value as a function of the intake manifold pressure P. Sun et al. then uses each of the different estimates only once to adjust engine operating parameters during the regeneration process.

In contradistinction to the teaching of Sun et al., Applicant's invention teaches the computation of a single estimate for the decrease in engine torque, which is then repeatedly used to compensate for the loss in engine torque during the entire regeneration process for the lean NOx trap.

In order for a reference to anticipate a claim, the reference must disclose each and every element of the claim. As exemplified by new claims 14-31, Applicant's invention is not then anticipated by the Sun et al. reference. The Sun et al. reference does not disclose the computation of a single estimate for the decrease in engine torque, which is then repeatedly used to compensate for the decrease in engine torque resulting from regeneration of a lean NOx trap as now set forth in new independent claims 14, 16, and 26. The Sun et al. reference also does not disclose that the single estimate for the feed-forward compensating torque can be computed based upon air-fuel ratios associated with the stratified lean engine operation and the homogeneous rich engine operation as now set forth in dependent claims 15, 21, and 27. Additionally, Sun et al. does not disclose that the single estimate for the feed-forward compensating torque can be computed based upon desired engine air charge per cylinder and

exhaust gas recirculation mass fraction as now set forth in new dependent claims 16, 22, and 28.

As presently claimed, the Applicant's invention also is not obvious in view of Sun et al., because Sun et al. teaches away from the approach of the present invention. As indicated above, Sun et al. teaches the computation of different estimates for the loss in engine torque during the regeneration process, where each estimate is used only once in adjusting engine operating parameter to compensate for the loss in engine torque. The present invention teaches the computation of a single estimate for the loss torque, which is then repeatedly used to adjust engine operation during the regeneration process to compensate for the loss in engine torque.

In addition, the approach disclosed in Sun et al. introduces error bias in the feed-forward control of individual engine operating parameters (fuel and/or spark), which further necessitates implementation of feedback control for these individual engine parameters based upon intake manifold pressure (see col. 4, line 62 - col. 5, line 4).

The Applicant recognized the deficiencies associated with the direct continuous feed-forward control of individual engine parameters such as described in Sun et al. (see the specification at paragraph [0007]), and has provided a simple more elegant control strategy that avoids these deficiencies. Applicant's invention provides for computing a single estimate for feed-forward compensating torque, which is repeatedly used during lean NOx trap regeneration in adjusting engine operation to compensate for loss of engine torque. The removal of the feed-forward compensating torque upon return to lean stratified operation is likewise simplified by the present invention as exemplified in Applicant's claims 17, 25, and 31.

Applicant has provided the amendments and arguments herein in a good faith effort to distinguish the present invention over Sun et al. The arguments specifically provided herein with respect to the independent claims 14, 20, and 26 apply with equal reasoning to all other claims depending from these independent claims.

Therefore, Applicant respectfully submits that all pending new claims 14-31 are patentable, and that such claims are in condition for allowance. Applicant respectfully requests allowance of the pending claims so the application can proceed to issue.

If the Examiner has any questions regarding the contents of the present response, he may contact Applicant's attorney at the phone number appearing below.

Any fees associated with this response may be charged to General Motors Deposit Account No. 07-0960.

Respectfully submitted,

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